Unlocking LiDAR Data for Use in Public Work Projects

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Agenda

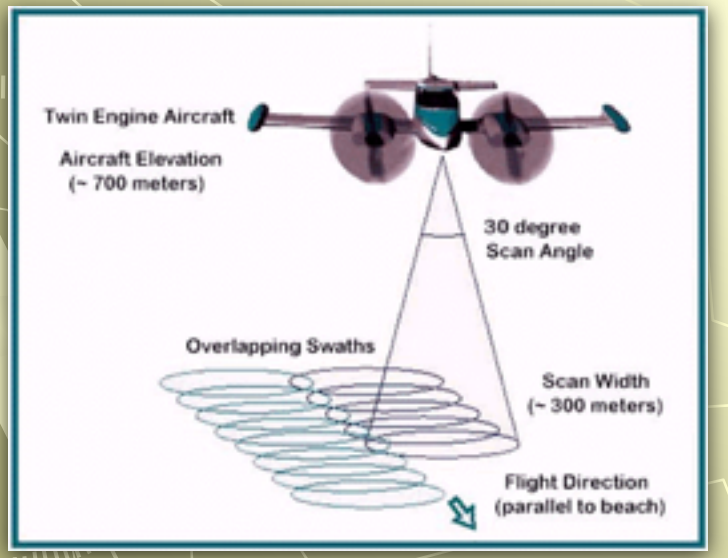
- What is LiDAR
- Monroe County LiDAR and how we made it usable for GIS users
- Limitations on the LiDAR Data
- Problems with Surveyors and the GIS data
- How we solved their problems to allow for the data to be used
- How the data is reducing costs
- Demo of the Tools

What is LiDAR

- LiDAR Stands for Light Detection And Ranging
- LiDAR was first developed in the late 1960s and was not fully commercialized until the early 1990s

How is Geographic LiDAR collected

- LiDAR is collected much the same way Orthoimagery is done



LiDAR Collection Continued

- As the plane flies over a surface an infrared (IR) beam is emitted from the sensor to the ground
- Elevations can be calculated based on the echo of the beam off of the ground
- Also because different surfaces absorb IR wavelengths differently the return will have a change in intensity which can be used to identify surface type or chemical composition

What does LiDAR Raw Data look Like

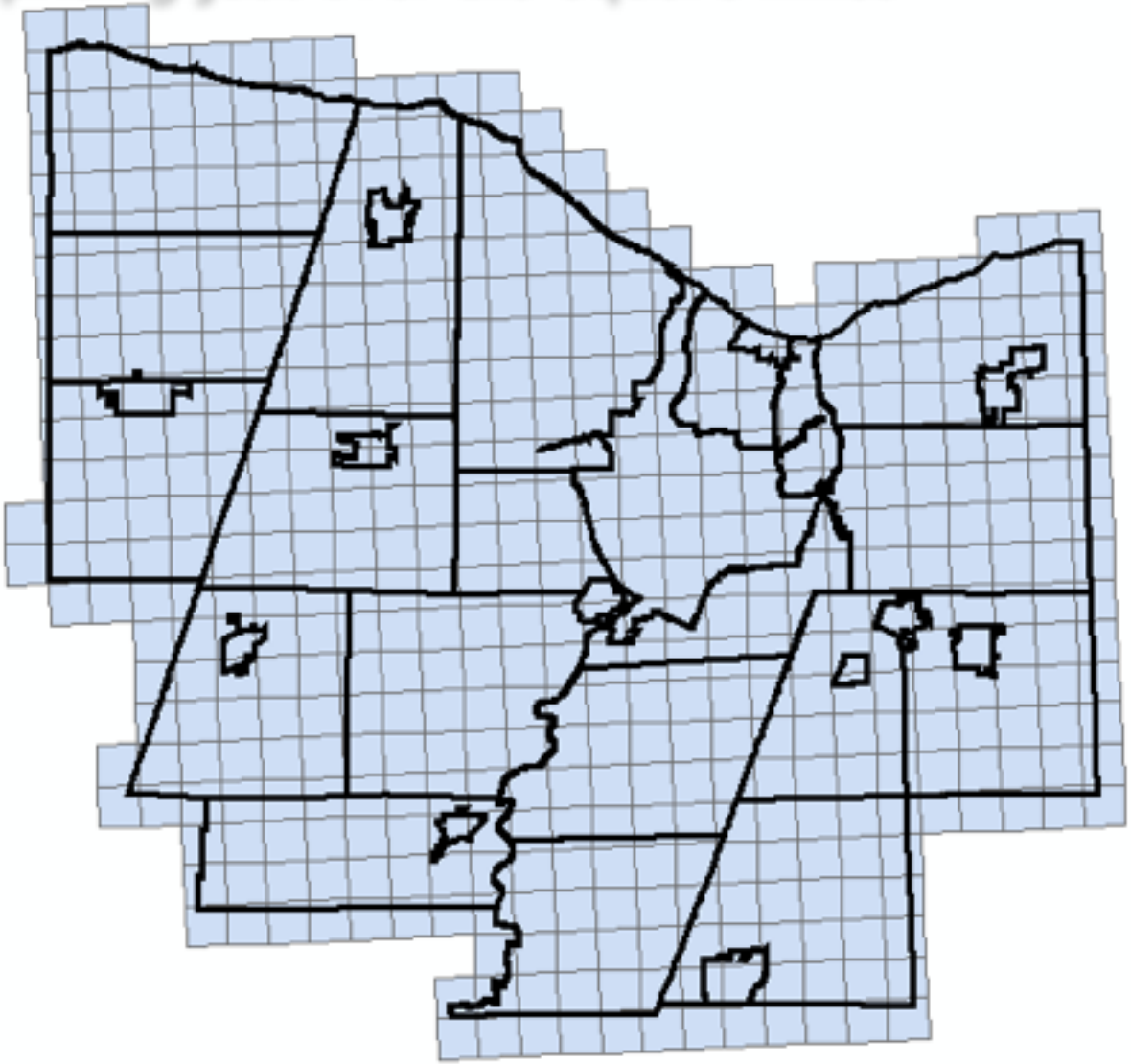
- LiDAR data is comprised of 4 attributes
  - X
  - Y
  - Elevation
  - Intensity

What does the Raw Data Look Like

EASTING	NORTHING	ELEVATION	INTENSITY
1355800.01000000000	1127581.62999999000	561.84000000000	66
1355800.02000000000	1125511.54000000000	534.51000000000	56
1355800.02000000000	1125728.90999999000	546.26000000000	48
1355800.02000000000	1127122.34000000000	563.89000000000	70
1355800.03000000000	1126544.83000000000	564.99000000000	53
1355800.04000000000	1125108.12999999000	532.59000000000	21
1355800.04000000000	1125284.62000000000	534.08000000000	29
1355800.04000000000	1125836.62000000000	549.45000000000	36

The average size of one of these tables are 13 Million records

Monroe County is broken down to 509 tiles each comprising just over 1.5 square miles

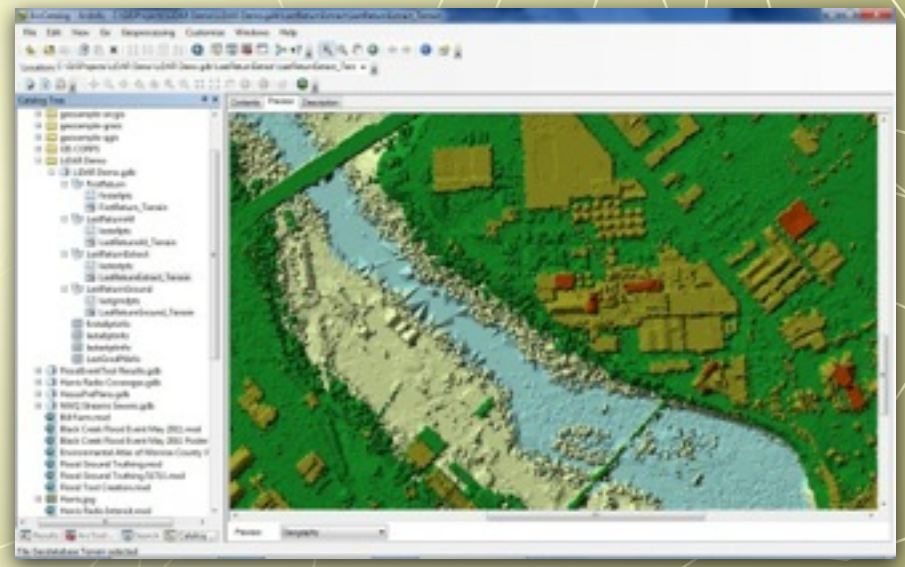


Monroe County LiDAR and how we made it usable for GIS users

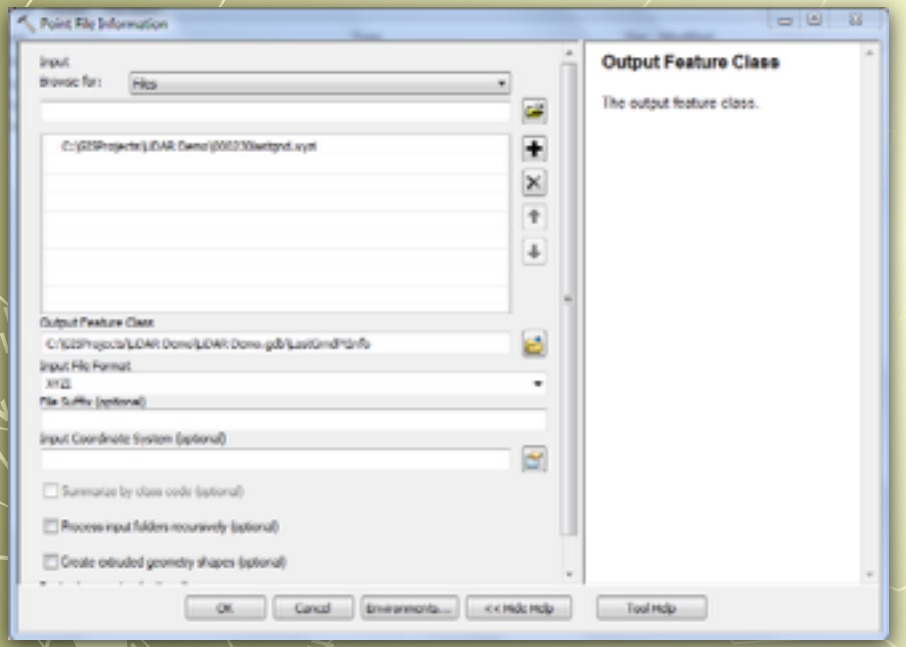
- The LiDAR data was collected in 2006 as part of a grant from FEMA's map modernization program
- The data format predates the acceptance of the ASPRS Las format
- When the data was delivered it was only the ASCII tables
- It took over a year to get the data usable for the County GIS
- **Need 3D analyst for all of these steps in ArcGIS for Desktop**

Monroe County LiDAR and how we made it usable for GIS users

- We ended up using the new Terrain model in 9.2
  - Pyramid Based Triangular Integrated Network Model
  - Great for rendering
  - Initially could not be analyzed
  - Must convert to raster
- But it could handle all of the data



Processing Points to Terrain



- Need **Point Spacing** for each area
- This is done using the Point File Information Tool
- Once you have the file click identify or preview the table and get the average point spacing

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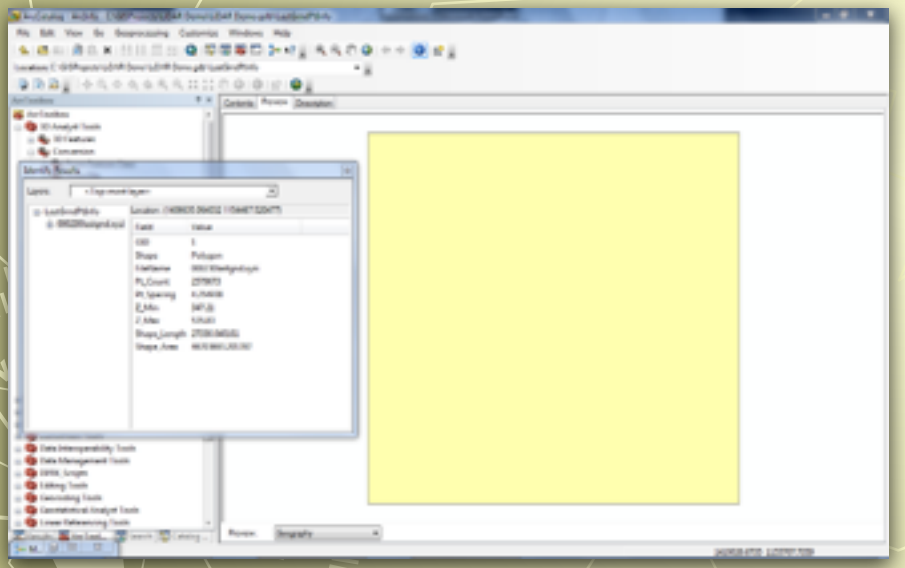

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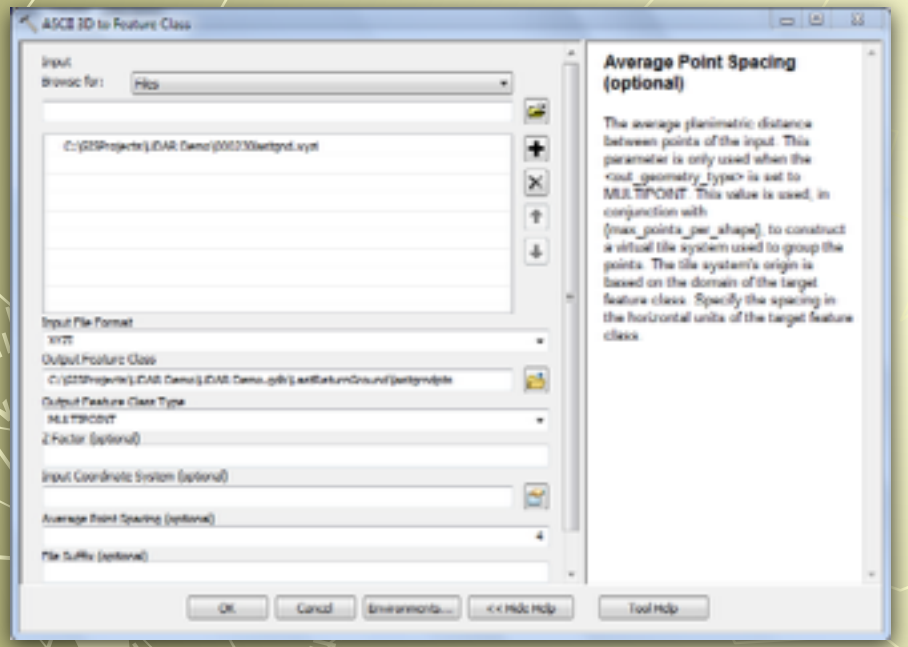

- Next you need to convert the tables to a multipoint feature using ASCII 3D to Feature Class
- The Point Spacing is required
- Once you have you multi-points in a Feature Dataset you can create a terrain

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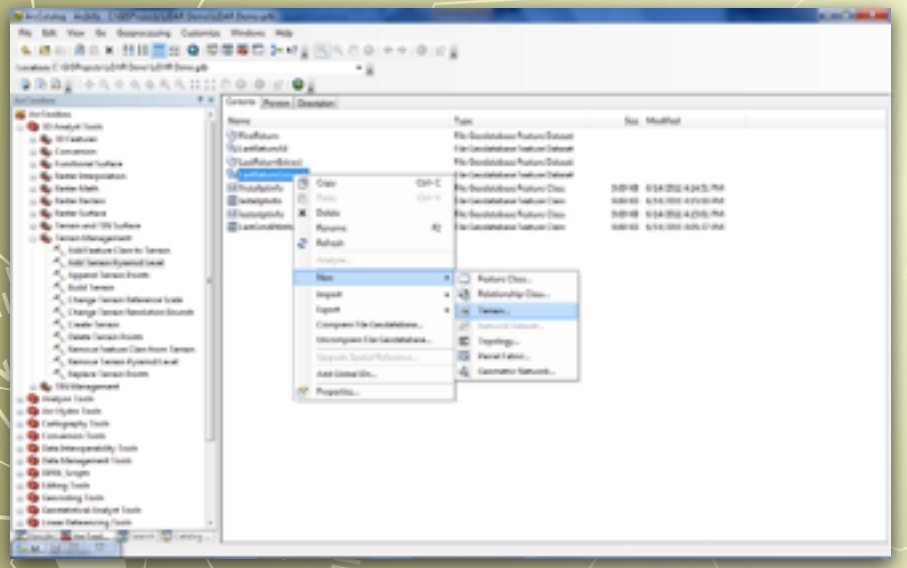

- Click on a feature dataset and new -> terrain
- Enter your point spacing (any multipoint feature class will be already loaded)
- Then confirm your dataset
- Set your pyramid levels (I use z tolerance and let the computer decide for me)
- Then Finish

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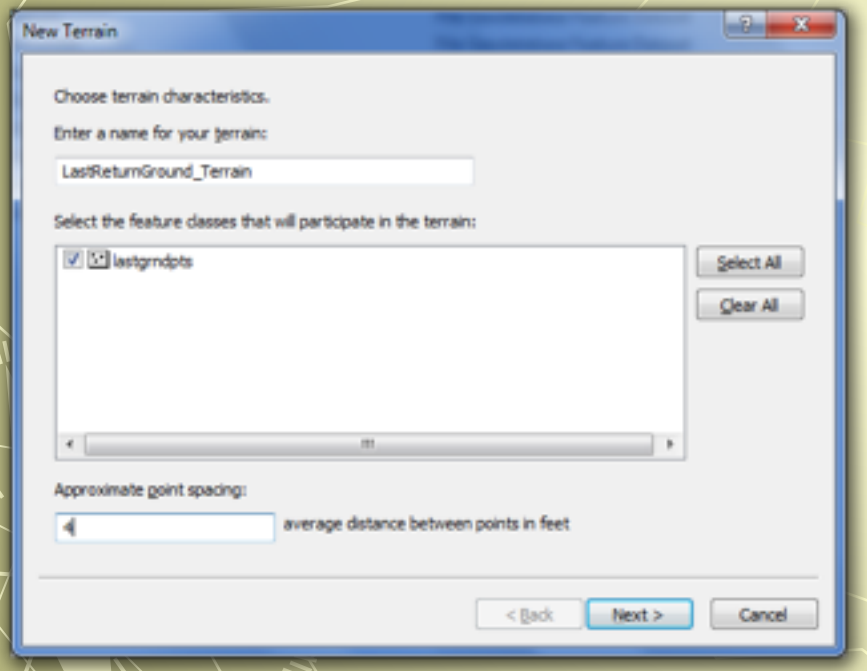

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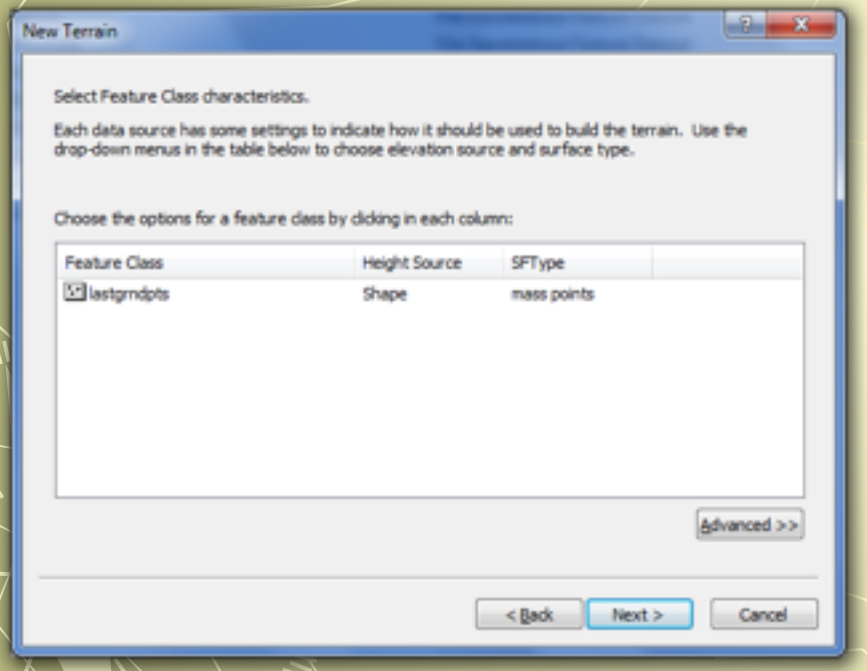

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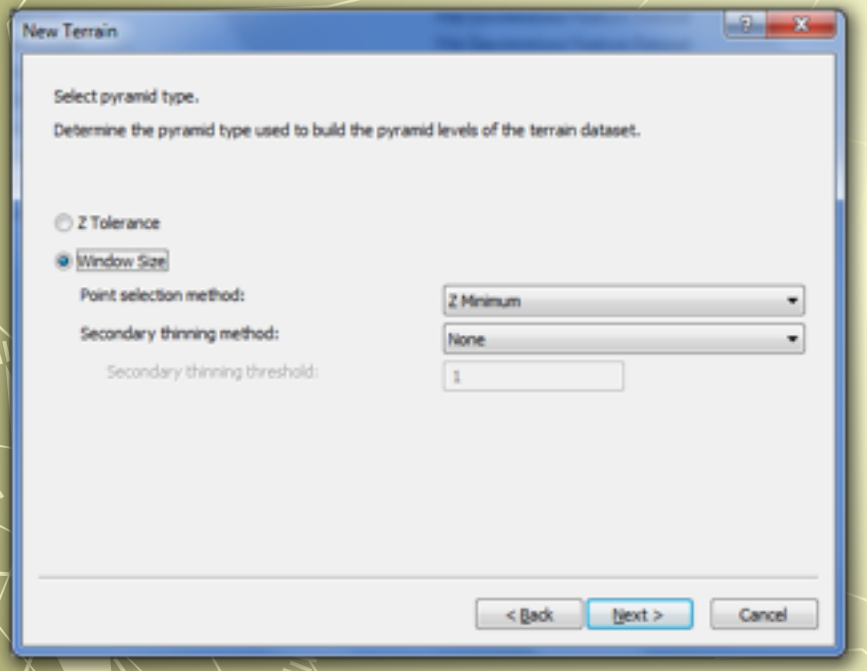

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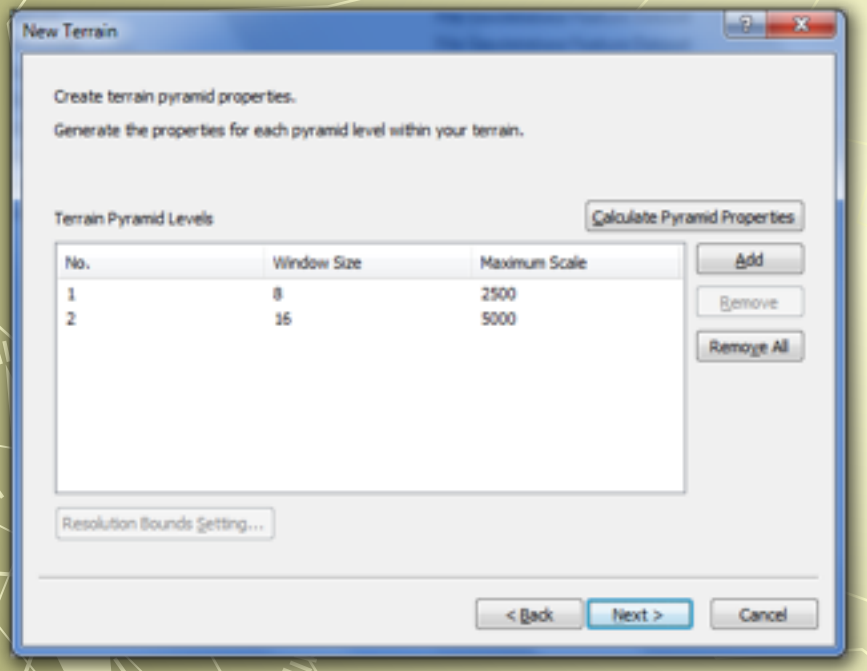

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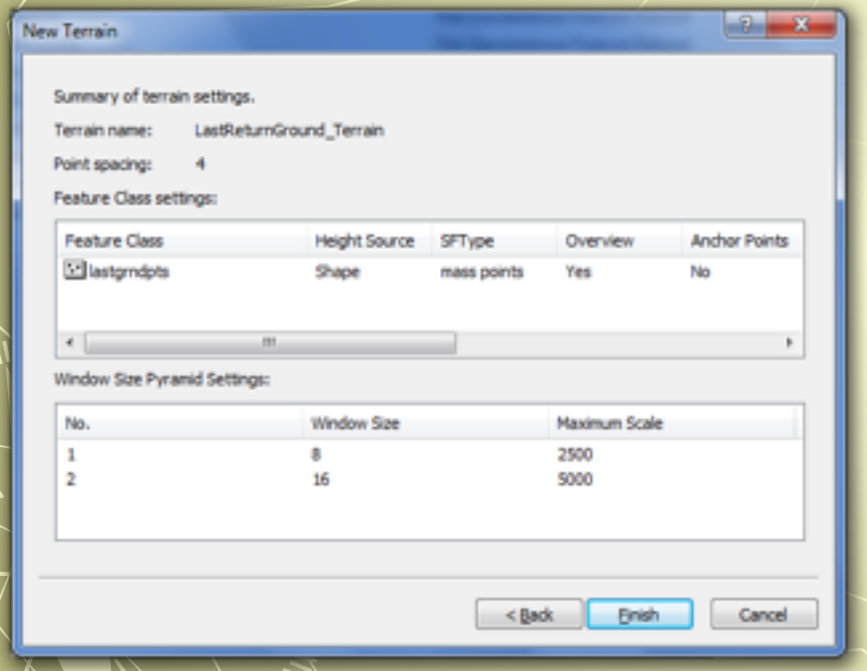

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- After creating the terrain let it build

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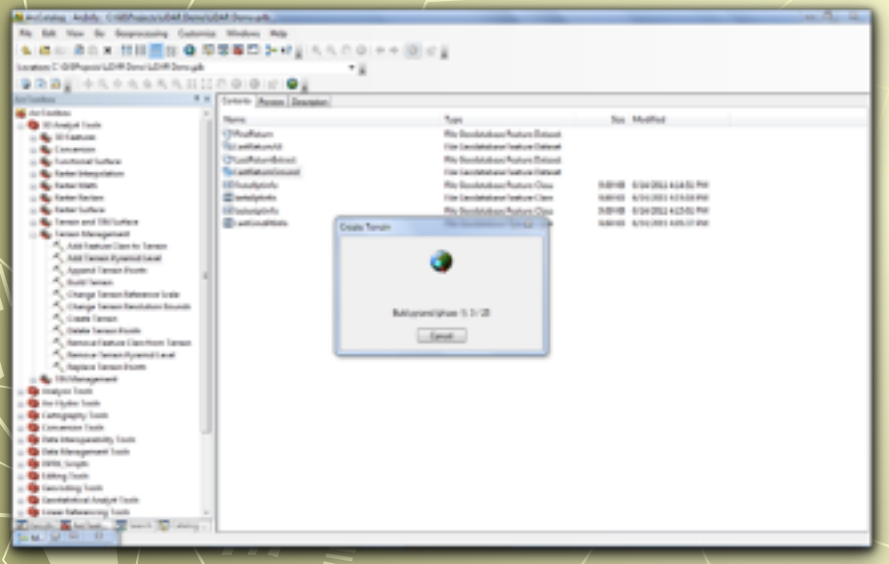

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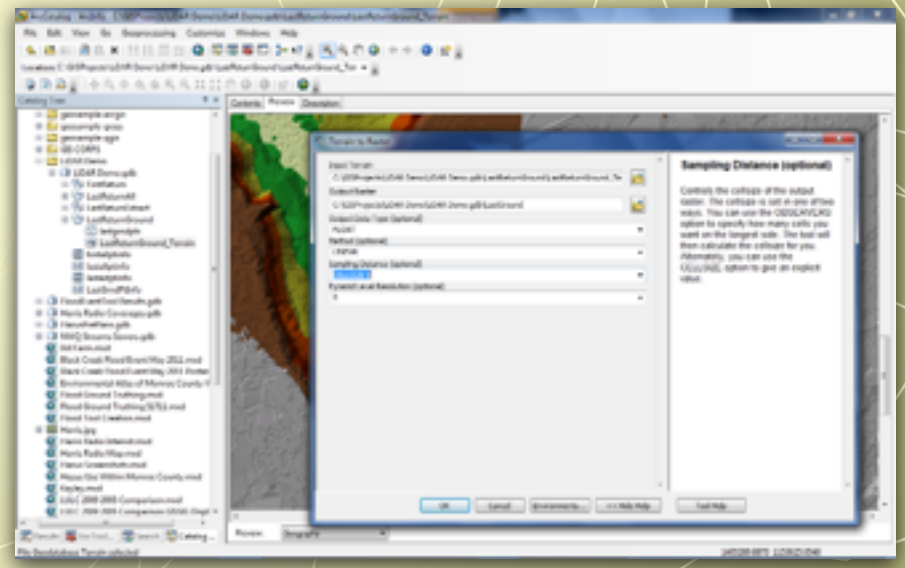
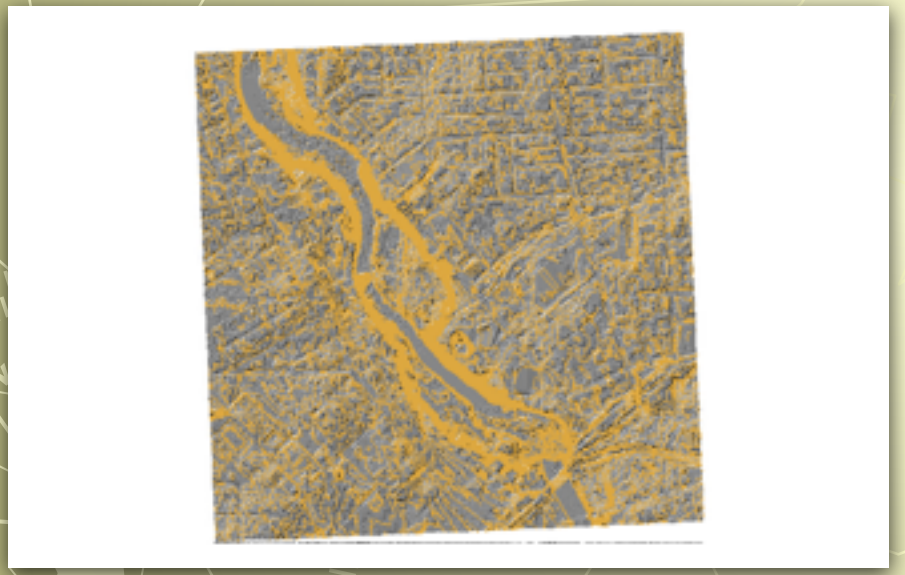
Terrain to Raster

- Conversion Tools -> From Terrain -> Terrain to Raster
- Save the raster anywhere (if you want a tiff save to a file with .tif at the end
- Make sure you set your cell size to the ground sampling size



Raster Derivatives



- Once in a Raster you can create contours, hill shades, or any other product you may need
- Contours can be generated to any value but the data is rated to a maximum of 2ft
- Any Contour less than 2ft is suspect to increased error and can result in too much data to be displayed

Limitations of the Data

- The light beam cannot penetrate tree cover and water
  - This prevents accurate readings at the forest floor except in areas where there are gaps in the canopy
  - Generally LiDAR cannot penetrate deeply into water due to LiDAR being in the IR wavelength
- Sheer Size of the data prevents usage
  - Storage (for example the Monroe County database there are 250 gigabytes of raw data)
  - Processing of the raw data to create datasets that are usable
- Snapshot of the area at the time of the flight
- Picks up small obstructions that move

Problems with Surveyors and the GIS data

- The surveyors that we have on contract cannot handle the seer size of the data
- They are using an AutoCAD type program which converts the contours and they try to display only their area
- The raw point tables are to dense for them to make a layer on their own system
- And they cannot work with the Raster elevations

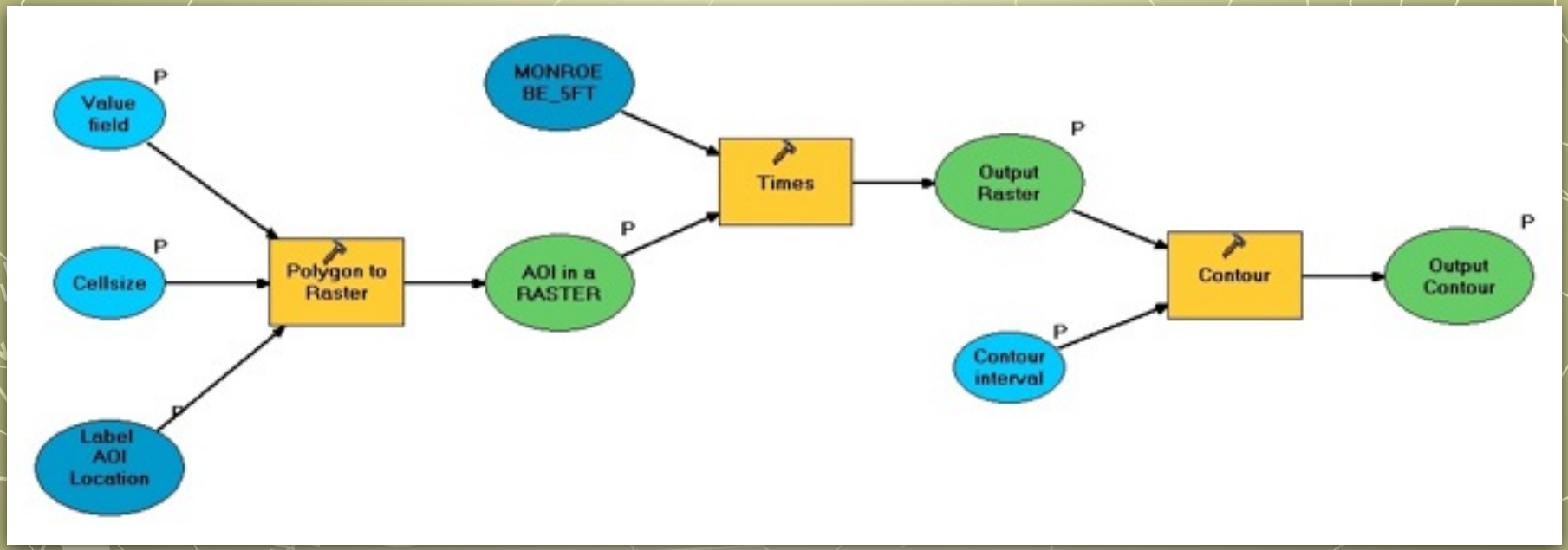
Problems with Surveyors and the GIS data

- So after many meetings of them trying to ask for everything only not to be able to use it, I got them to tell me what they needed to work with the project
- I made two tools to clip or extract the data
- The Clip tool regenerates the data into a smaller raster and can create contours at their needed interval
- The other is a tool for spot elevations
- These tools were first created in 9.3.1 and work the same in 10 - 10.2 with only one change
- ArcGIS 10 and above can also use the terrain data for interpolating spot elevations

The LiDAR Clip Tool

- For a clipping of LiDAR data there must be a projected polygon area of interest (AOI) with a value of 1 for the area needed (preferably in State Plane NAD 1983 New York West Feet 3103, which matches our projection)
- The polygon is then inserted into a tool and it generates the clipped LiDAR
  - With the tool you can have any logical contour interval

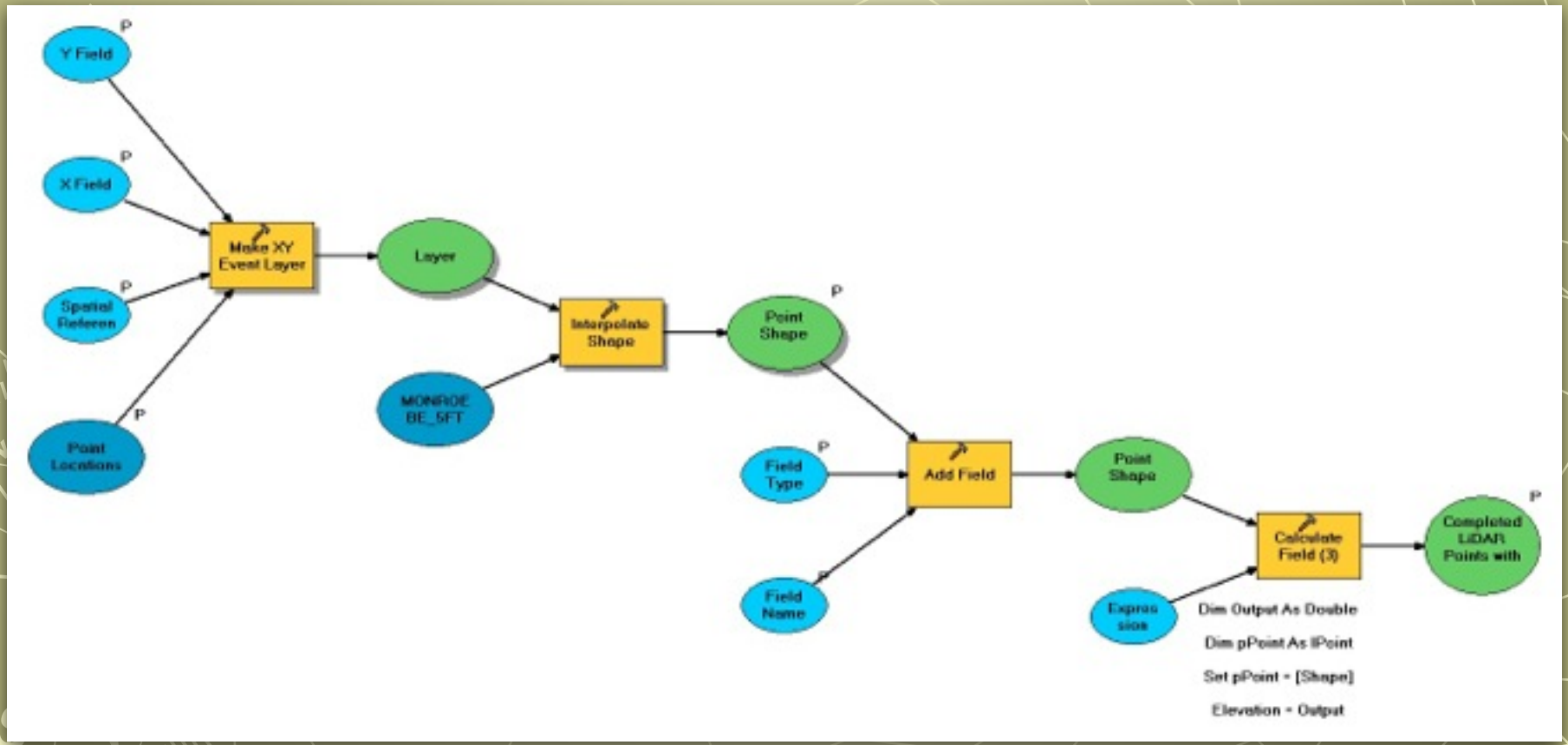
The LiDAR Clip Tool



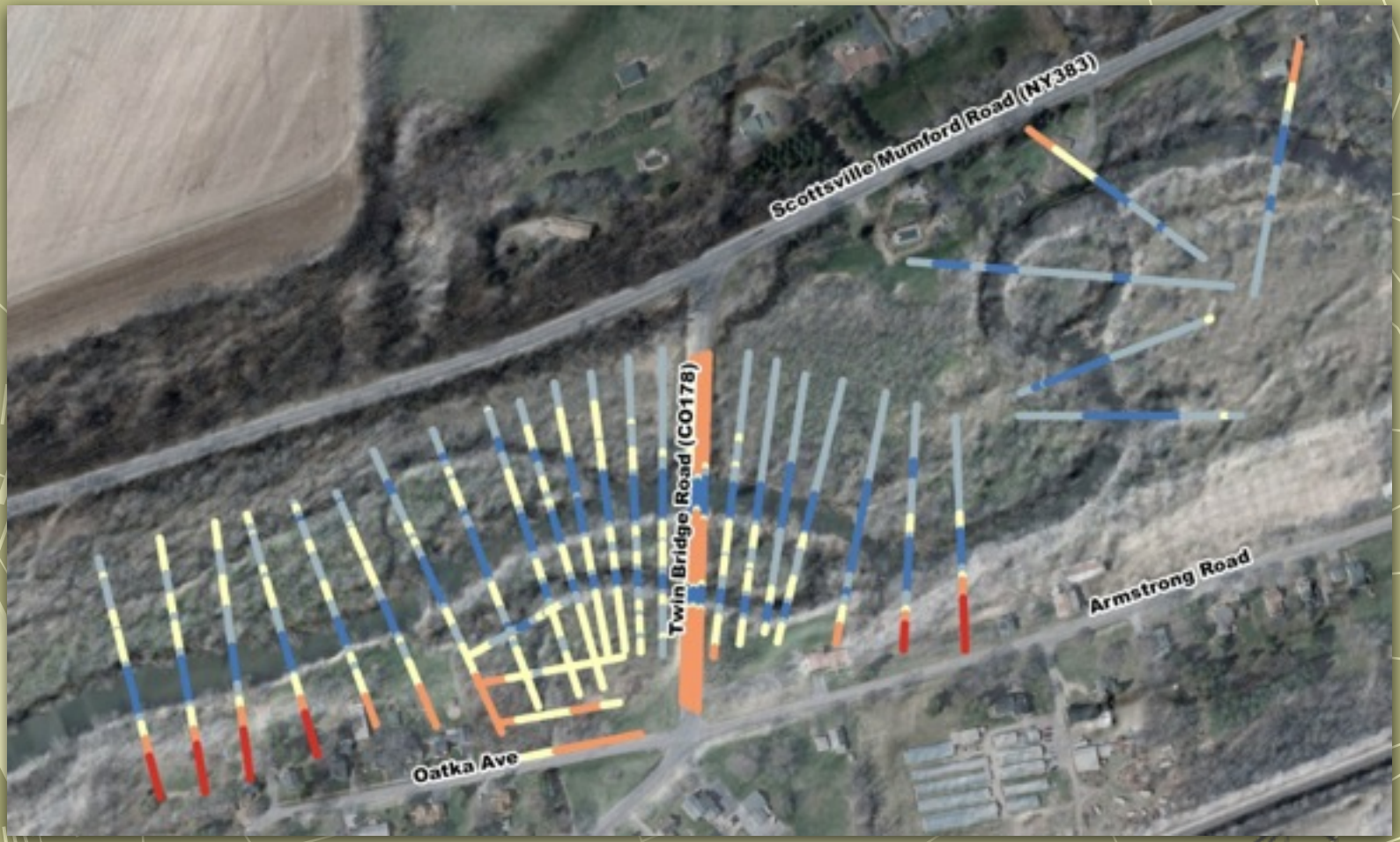
Spot Elevations Tool

- For spot elevations you need a table of coordinates
- Then using the tool the computer can plot the points and then fill in the elevations
- This is handy when you have predefined transects and want to compare the data to survey data
- In 10 and above you no longer need the VB script to extract the elevations, you can now calculate z values right from the tool box

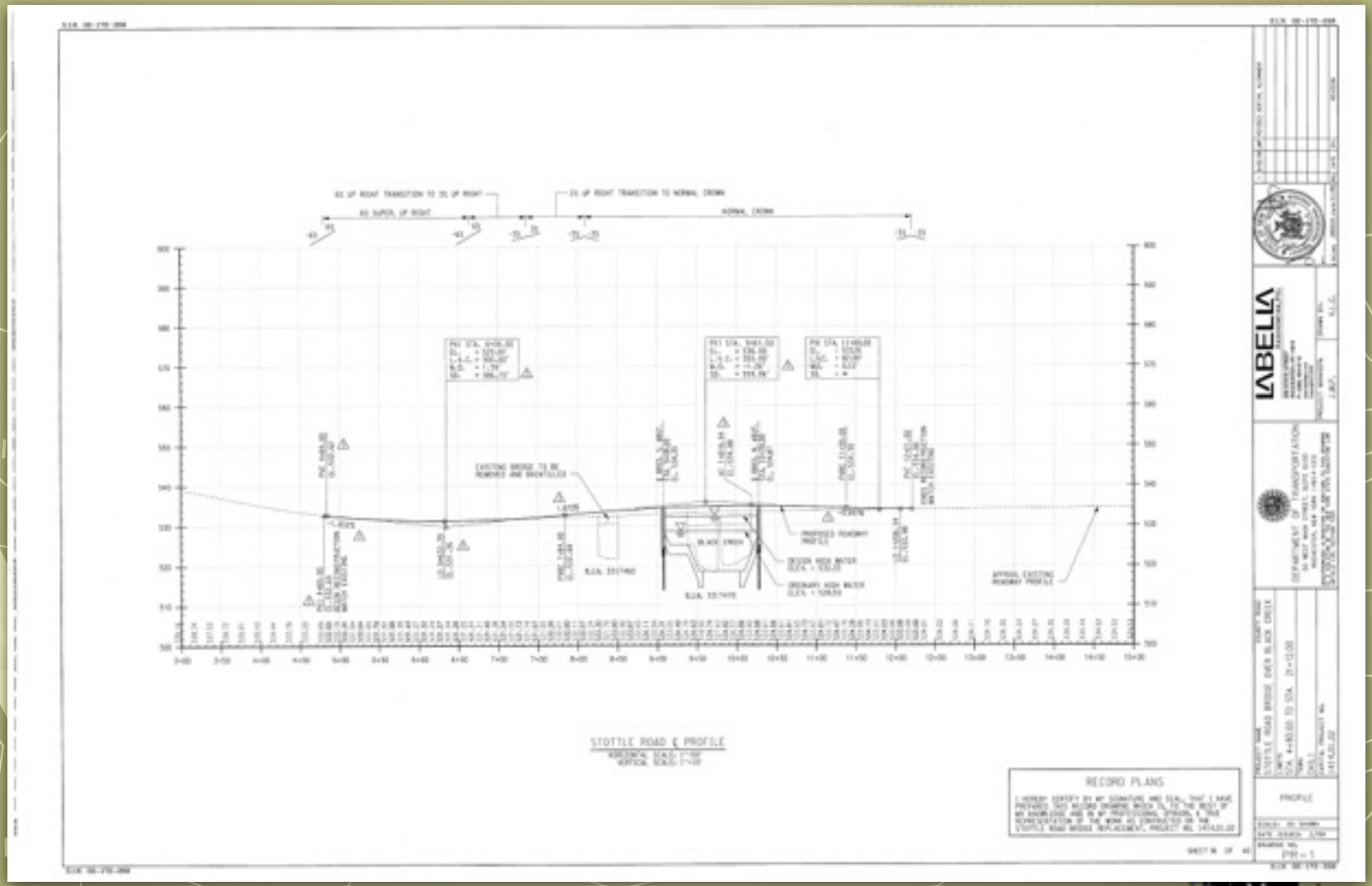
Spot Elevations Tool



Example of Spot Elevations



Final Product Usage



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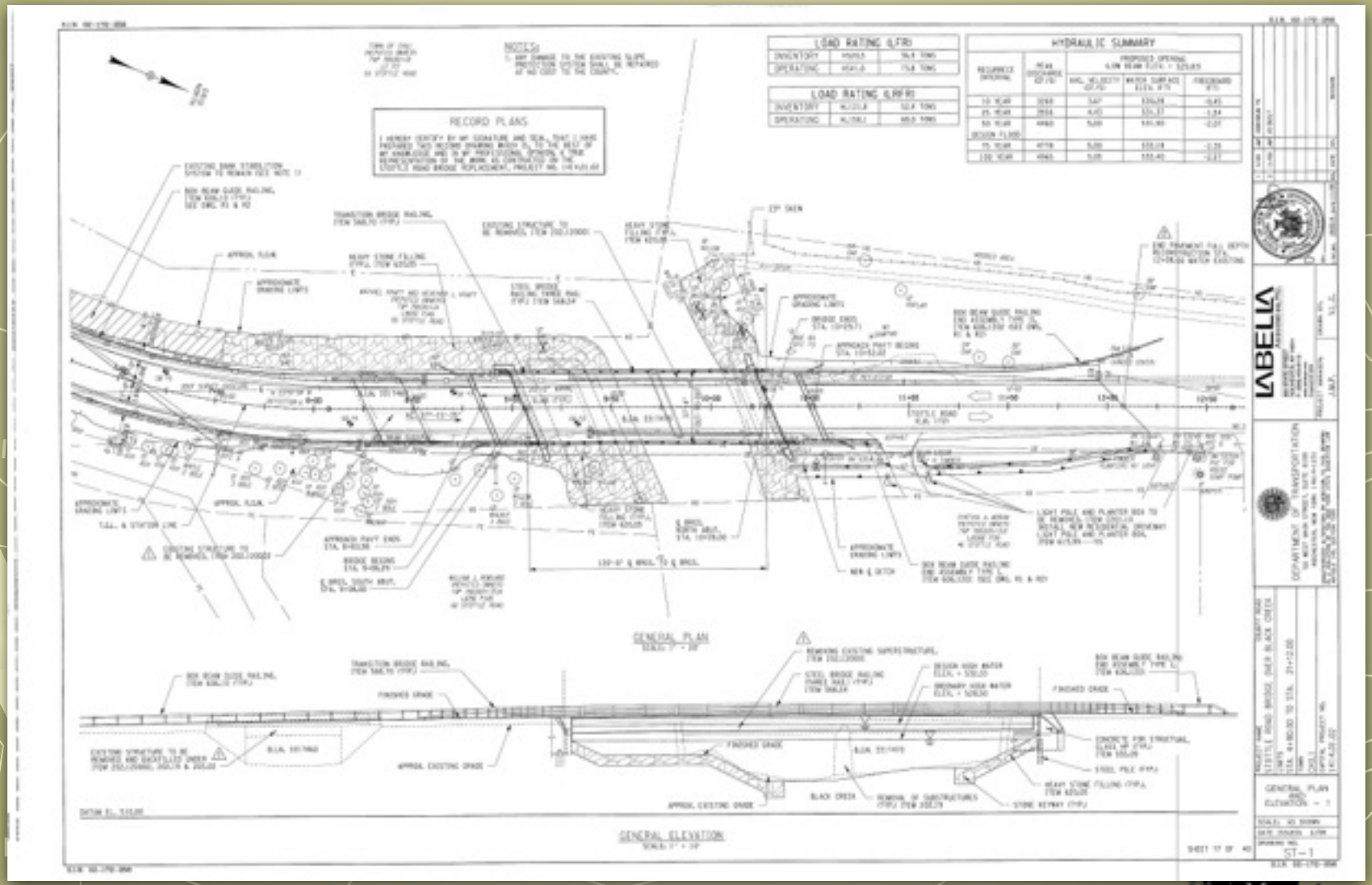

How this is reducing costs in Monroe County

- Now all Transportation, Sewer, and Water project has a pre-survey done with the LiDAR
- Areas where the LiDAR is unsure (tree covers, edge of structures, under water, etc.) are surveyed as well as spot checks on the LiDAR itself
- Plans and cost analysis can be run in a few days instead of a few weeks of the surveyor's time
- The Project manager can better estimate the amount of work needed for a projects thus reducing waste
- One note, this is only another tool for our surveyor's because LiDAR cannot entirely replace field data

Questions and Demo

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Mapping Monroe
GIS Services Division
Department of Environmental Services